

What is Claimed is:

1 1. A separator for electrochemical cells, comprising:
2 a gas barrier having an electrically conducting pathway extending therethrough;
3 a porous, electrically conducting member in electrical contact with each side of the
4 electrically conducting pathway, the member selected from the group consisting of expanded metal
5 mesh, metal foam, conducting polymer foam, porous conductive carbon material and combinations
6 thereof.

1 2. The separator of claim 1, wherein the electrically conducting pathway through the gas barrier
2 is formed from a second porous, electrically conducting member selected from the group consisting
3 of expanded metal mesh, metal foam, conducting polymer foam, porous conductive carbon material
4 and combinations thereof.

1 3. The separator of claim 1, wherein the gas barrier is a metal.

1 4. The separator of claim 1, wherein the gas barrier comprises a polymer.

1 5. The separator of claim 1 further comprising a cooling fluid channel within the gas barrier.

1 6. The separator of claim 1, wherein the gas barrier and the porous, electrically conducting
2 member are essentially parallel.

3 7. A separator for electrochemical cells, comprising:
4 a porous, electrically conducting sheet selected from the group consisting of expanded metal
5 mesh, metal foam, conducting polymer foam, porous conductive carbon material and combinations
6 thereof; and

7 a gas impermeable material disposed within a portion of the sheet to form a gas barrier.

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1 8. The separator of claim 7, wherein the gas impermeable material is selected from the group
2 consisting of polymers and metals.

1 9. The separator of claim 7, wherein the gas impermeable material is a polymer selected from
2 the group consisting of water permeable polymers, thermoplastic polymers, reactively cured
3 polymers, and combinations thereof.

1 10. The separator of claim 7, wherein the gas impermeable material is an epoxy.

1 11. The separator of claim 7, wherein the gas impermeable material is a thermoplastic polymer
2 selected from the group consisting of polyethersulfone (PES), nylon, and polycarbonate.

1 12. The separator of claim 7, wherein the gas impermeable material is a perfluorinated sulfonic
2 acid polymer.

1 13. The separator of claim 7, wherein the gas impermeable material is selected from the group
2 consisting of titanium, stainless steel, aluminum, magnesium and alloys thereof.

1 14. The separator of claim 7, wherein the gas barrier is formed along one face of the porous
2 sheet.

1 15. The separator of claim 7, wherein the gas barrier is formed within a central portion of the
2 porous sheet.

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16. The separator of claim 7, further comprising a second porous, electrically conducting sheet selected from the group consisting of expanded metal mesh, metal foam, conducting polymer foam, porous conductive carbon material and combinations thereof, wherein the second porous sheet is in electrical contact with (the side of the porous sheet) having the gas barrier.

17. The separator of claim 6, wherein the cooling fluid channel.

18. The separator of claim 16, wherein the cooling fluid channel is disposed through or in contact with the gas impermeable material.

19. The separator of claim 17, wherein the cooling fluid channels comprise a plurality of cooling fluid tubes.

20. A separator for electrochemical cells, comprising:
two porous, electrically conducting sheets selected from the group consisting of expanded metal mesh, metal foam, conducting polymer foam, porous conductive carbon material and combinations thereof; and
an electrically conducting gas barrier disposed in electrical contact between the sheets.

21. The separator of claim 18, wherein the electrically conducting gas barrier is a metal sheet.

22. The separator of claim 19, wherein the metal sheet is titanium.

23. The separator of claim 19 further comprising a polymeric cell frame peripherally enclosing a porous electrically conducting sheet.

Subj 1 24. The separator of claim 23 wherein the polymeric cell frame includes channels in fluid communication with the porous electrically conducting sheet.

1 25. The separator of claim 20, wherein the porous, electrically conducting sheets have
2 interdigitated channels communicating to the edge of the sheets.

1 26. The separator of claim 20 further comprising a cooling fluid channel within the electrically
2 conducting gas barrier.

1 27. A fluid cooled bipolar plate comprising:
2 an electrically conducting anode flow field;
3 an electrically conducting cathode flow field; and
4 an electrically conducting cooling fluid flow field in electrical communication between the
5 anode flow field and the cathode flow field, wherein the cooling fluid flow field includes fluid
6 impermeable barriers defining a fluid passage.

1 28. The fluid cooled bipolar plate of claim 27 further comprising cooling fluid inlet and outlet
2 manifolds connected to the cooling fluid flow field.

1 29. The fluid cooled bipolar plate of claim 27 further comprising a frame disposed around the
2 cooling fluid flow field.

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